International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

A Review on the Traditional and Modern Dressings for Wound Healing

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Abstract: ***An appropriate environment is required to aid the complex and dynamic healing of wounds. More than 3000 formulations have been developed as a result of technological advancements to treat various types of wounds by focusing on different components of the healing process. The current review examines the features and drawback of the dressing materials and chronicles the development of dressings from their earliest uses to the present.***

Keywords: Wound healing, Wound dressings, Traditional dressings; Modern dressings

1. Introduction

The biological process of healing a wound is complex and has several distinct phases, such as haemostasis, inflammation, cell migration and proliferation, and tissue remodelling [1]. A proper wound management is necessary to maintain a moderate environment for nutrients exchanging, inhibit inflammation, protect the injured tissue from external factors, and induce wound closure and tissue regeneration in order to achieve effective wound healing with nominal scarring and maximum structure and function restoration. A dressing is one of the easiest and most common ways for managing wounds as it can be easily applied as a physical barrier to cover a variety of superficial wounds, including burns, skin cuts, wounds caused by trauma or surgery, and infected wounds, and it also offers a moist and secure environment for healing. Innovations in biomaterials and regenerative medicine have demonstrated an enormous potential for creating the ideal wound dressing material, which can be applied easily, protect the wound bed from the outside environment, regulate the wound microenvironment, prevent inflammation, promote revascularization, and shorten the time it takes for a wound to heal [2–4].

2. Factors Affecting Wound Healing

Interactions between cytokines, growth factors, blood, and the extracellular matrix lead to wound healing. The cytokines stimulate the creation of basement membrane components, prevent dehydration, increase inflammation, and promote the growth of granulation tissue, among other processes that aid in healing. Numerous local and systemic variables have an impact on these pathways [5]. Local variables, such as cold, pain, infection, radiation, and tissue oxygen tension, have a direct impact on the wound's features, whereas systemic factors, such as an individual's general health or disease status, have an impact on that person's capacity to heal [6]. In addition to these variables, a lack of protein, vitamins, and minerals as well as advancing age might slow the healing process.

3. Wound Healing, Hindrances, and Optimization Irregular Wound Healing.

Inflammation, proliferation, and remodelling are the three consecutive and overlapping phases that may be used to characterise the fundamental components of wound healing. Chronic wounds—those that are still unhealed after 4 weeks—are those that are stuck in a certain stage of wound healing and are unable to advance. Chronic wounds are brought on by a number of reasons, including infection, ischemia, and old age. 5 The body's intrinsic capacity for healing may be hindered in individuals who are considered difficult or have multiple factors.

Clinical Relevance: A steady and adequate supply of oxygen, nutrients, enzymes, and cells are necessary for wound healing. The wound bed will be ready for advancement in wound healing if the aforementioned elements are under control and sufficient debridement and moisture management have been applied. In this article, products that seek to create a wound bed that is ready for healing will be described along with their relative impact when it is known.

Matrix metalloproteinases (MMPs), among other local variables, also contribute to the healing of wounds. All wounds include these proteolytic enzymes, which encourage cell migration, control physiologically active molecules, and aid in the remodelling of extracellular matrix. These enzymes may be overproduced in chronic wounds with large exudates, which might lead to an early breakdown of collagen and fibronectin. Retaining MMPs at their optimum level can help reduce chronic inflammation and the destruction of vital growth factors. This is accomplished by keeping in mind the idea of regulating exudates in wounds. [7]

Bacterial Load: Most wounds get infected within 48 hours and eventually turn into hosts for bacteria. Although the exact threshold at which bacteria impair wound healing is still debatable, the amount of bacteria on a wound should be considered along a continuum. Regarding the presence of germs, there are four groups that may be assigned to

wounds. Infected wounds contain a small number of non-replicating microorganisms. Micro flora that is attached to the body's surface and forms colonies in colonised wounds. There is no obvious host reaction at this time. When a wound is heavily colonised by bacteria, this causes a bio burden and prevents the healing process from starting. At this point, additional indications of impending infection start to appear, including an increase in serous exudates, friable granulation tissue, a change in the colour of the granulation tissue to bright red, a worsening of the pain at the site of the wound, an increase or unusual change in the smell of the wound, and breakdown of the wound from lack of tissue. Infection marks the end of the continuum. Bacteria have now entered the tissue, are growing, and are triggering a host response. Fever, warmth, edoema, swelling, discomfort, erythema, and purulent discharge are common signs and symptoms. More than 105 colony-forming bacterial units will be present per cubic millimetre of tissue in infected wounds [8].

4. Characteristics for an Ideal Wound Dressing

A proper dressing material must be applied based on the kind of wound. The ability of a dressing to: a) provide or maintain a moist environment; b) facilitate epidermal migration; c) encourage angiogenesis and the synthesis of connective tissue; d) permit gas exchange between wounded tissue and the environment; e) maintain appropriate tissue temperature to improve blood flow to the wound bed and facilitate epidermal migration; f) provide protection against bacterial infection; and g) should not stick to the wound and be simple to remove once it has healed h) must serve as a debridifier to encourage leucocyte movement and boost the build-up of enzyme I The item must be sanitary, non-toxic, and allergy-free.

Since the beginning of time, a variety of substances have been applied to wounds in an effort to halt bleeding, absorb exudates, and speed up healing. Honey, animal oils or fat, cobwebs, dirt, leaves, sphagnum moss, or animal faeces were a few of these materials [9]. Some of these easily accessible natural ingredients, like honey, have been researched and proved to have some use, despite the fact that most of them would eventually prove to have little benefit. What is known is that wounds are more likely to heal in a warm, wet environment [10]. A wet wound bed will encourage the migration of growth factors and a variety of cell types, including epithelial cells, which will aid in the constriction of the wound edge. Appropriate dressings are used to establish and sustain this environment [11].

5. Wound Dressings

The creation of wound dressings that can stimulate and promote wound healing is a result of the advancements made in the 20th and 21st century. Specialists in wound care and podiatrists now have a range of choices to choose from for their patients. Modern wound dressings are capable of providing autolytic debridement in addition to maximising moisture in the wound microenvironment, limiting wound infection, and reducing discomfort from wounds.

Gauze: Gauze became the most popular surgical dressing after Johnson & Johnson started mass manufacturing sterile surgical dressings in 1891 by sterilising cotton yarn and thread [12]. Gauze is unquestionably well-known to medical workers, affordable, dependable, accessible, and very absorbent. There are two types of gauze: woven and nonwoven, the latter of which is more absorbent and is formed of compressed synthetic fibres. It can be used as a primary or secondary wound dressing since it is extremely permeable and non-occlusive. Despite the fact that gauze has been effective in many circumstances, medical professionals and hospital workers need to be aware of when it is not the best choice to utilise it. It takes effort to remove woven gauze, which may result in mechanical debridement or wound damage.

Impregnated gauze: There are additional gauze dressings available that have been infused with materials including petroleum, iodine, bismuth, and zinc. These dressings are mildly occlusive and non-adherent thanks to the impregnated ingredients. By minimising desiccation during dressing changes and adding moisture to the wound bed, they lessen damage and promote wound healing. They can work effectively as primary non-adherent dressings or as a contact layer on granulating wound beds when used in conjunction with secondary gauze dressings. They are frequently used as a single layer as the main dressing on donor sites for skin grafts, covering the actual skin transplant. Because it can be removed painlessly, impregnated gauze is also frequently used to burn wounds [13].

Transparent films Dressing: Transparent film dressings are thin, flexible transparent sheets made of polyurethane or co-polyester with an adhesive backing. They are impenetrable to bacteria and water but permeable to oxygen, carbon dioxide, and water vapour. They support autolytic debridement and offer a wet healing environment. Since they are incapable of absorbing anything, they play no part in wounds with copious exudates. This material shouldn't be used to cover infected wounds since it provides the perfect habitat for germs to grow when there is inadequate drainage. Transparent films are frequently used to cover regions of friction, skin graft donor sites, superficial wounds with little exudate, and surgical incision sites that have been closed [14, 15].

Foam dressings: Foam dressings are permeable to both gases and water vapour and have a polyurethane foundation. They offer both heat insulation and excellent absorption because to their hydrophilic characteristics. These incredibly adaptable dressings should be used on moderate-to-heavy exudative wounds, partial- and full-thickness wounds that are granulating or slough coated donor sites, ostomy sites, mild burns, and diabetic ulcers. Due to their capacity to cause wounds to become even drier, they are not advised in dry or eschar-covered wounds and vascular ulcers. They can stay in place for up to 4 to 7 days, but once they get saturated with exudates, they need to be replaced. When removed, they cause damage due to their makeup. They can be used to infected wounds if changed daily [16].

Hydrogels: Complex hydrophilic organic cross-linked polymers called hydrogels have a base that is 80%–90%

water. These gels can be found as fixed flexible sheets or free-flowing amorphous gels. They have a limited capacity for fluid absorption through swelling, but they may also contribute moisture to a dry wound, aiding in autolytic debridement and maintaining a moist, thermally insulated wound environment. They have also been demonstrated to lower the temperature of a wound bed by up to 5 C and to induce granulation and epithelialization [17,18]. They have shown to be a less efficient bacterial barrier than occlusive dressings and are permeable to gas and water. These dressings are primarily used to moisten dry wound beds and to soften and remove slough and necrotic wound debris.Due to their high water content, they are unable to absorb substantial drainage; they absorb extremely slowly and are consequently useless on bleeding wounds; and they typically need for a secondary dressing.

Hydrocolloids: The inner layer of hydrocolloid dressings is made up of hydrophilic colloid particles like carboxymethylcellulose (CMC), pectin, gelatine, or an elastomer, and it is self-adhesive, gel-forming, and hydrophilic. This layer takes in exudates and enlarges over the incision to resemble a gel. In addition to providing the wound bed with thermal protection, this enables a moist healing environment. The outer layer, which is often made of polyurethane, seals the wound and guards it from bacteria, foreign objects, and shearing. These dressings are offered in a range of shapes and sizes, as well as in paste, powder, and granule forms. These dressings are useful because they can stimulate autolytic debridement, avoid infection, maintain a moist healing environment, and eliminate the need for a second dressing.They may be left in place for as long as 7 days or until drainage is apparent from the dressing's base [19].

Alginates: Alginates are another dressing that doctors can use to wounds with excessive exudate. They are coated in calcium/sodium salts and contain alginic acid from seaweed. These dressings feature nonwoven fibres made from brown sea weed, are non-adherent, biodegradable, very absorbent, and may also contain controlled-release ionic silver. When applied to a wound, serum and sodium and calcium ions combine to create a hydrophilic gel. Due to its ability to provide a moist wound environment, high absorption rate, and ability to stop microbial contamination, alginates are beneficial. Alginates may absorb 20 times their weight in fluid; however this varies depending on the product. Highly draining wounds, pressure/vascular ulcers, surgical incisions, wound dehiscence, tunnels, sinus tracts, skin transplant donor sites, exposed tendons, and infected wounds can all be effectively treated with these dressings. Alginates may also have haemostatic qualities that make them helpful in treating bleeding wounds. Due to their propensity to encourage absorption and lack of hydration properties, these dressings are contraindicated for dry wounds. [20, 21].

Hydrofibers: The sodium CMC-based hydrofiber dressings react with the serum or exudates to create a gel. Convatec Ltd. introduced the Aquacel brand in 1997, which is made entirely of CMC fibre. Alginates and hydrofibers share a number of structural and functional similarities. They are accommodating to severely exuding or infected wounds and are pleasant and simple to remove. Due to their extremely absorbent nature, hydrofibers have been shown to be beneficial in lowering MMP and bioburden levels. In Aquacel Ag, they have also been mixed with silver. Until they get saturated, these dressings may be retained in place for up to 3-7 days [22].

Silicone dressings: A hypertrophic or keloid scar can result from abnormal wound healing, as mentioned earlier in this article. In the past, pressure garments have frequently been worn for a prolonged period of time to treat symptoms. In 1981, it was discovered that using a silicone gel sheet consisting of poly-dimethylsiloxane might supplement or perhaps completely replace the advantages of pressure treatment. This would allow for a levelling impact on the hypertrophied region by relaxing or softening the scar tissue [23]. At this moment, the exact mechanism of silicone gel sheeting action is not known. A common theory proposes that the changed local environment under the silicon layer, where there is less vapour loss, permits hydration of the scar [24].

Silver dressings: There is a lot of debate about the use of topical antibiotics to wounds. A renewed interest in silver-based medications is a result of worries about bacterial resistance. For thousands of years, silver has been utilised in medicine for its antibacterial qualities. Its usage in surgical patients was originally noted by John Woodall in The Surgeons Mate in 1617. Silver is a prevalent ingredient in many dressings and topical products nowadays. With regard to bacteria, fungi, viruses, and yeast, silver is a versatile antibacterial agent. When taken at the proper dose, it has also been demonstrated to be effective against MRSA and vancomycin-resistant enterococci (VRE) [25]. Additionally, silver is believed to lessen wound irritation and speed up recovery.The local wound environment affects the amount of silver required to have a bacteriostatic or bactericidal impact. [26].

Charcoal dressings: By absorbing gases produced by bacteria, activated charcoal dressings serve the primary purpose of reducing wound odour. They may absorb odour molecules due to their huge surface area and function as a deodorising agent. Wound odour is very subjective in nature since it is hard to define and quantify. Leg ulcerations and other forms of fun gating lesions are the wounds most frequently linked to the generation of odour. Numerous aerobic bacteria as well as anaerobes including Bacteroides and Clostridium species are among the organisms usually linked to malodorous wounds. Additionally, studies have revealed that some wound odours may be unique to a species. [27-29].

6. Conclusion

There are already more than 3000 different types of dressings on the market, allowing doctors to handle all facets of wound care. However, there is still no better treatment for treating chronic wounds including venous leg ulcers, diabetic wounds, and pressure ulcers, which frequently do not heal completely. Therefore, creating a dressing material that tackles the main variables that interfere with the natural healing process will greatly benefit patients and wound care professionals.

References

[1] Martin P, Nunan R. Cellular and molecular mechanisms of repair in acute and chronic wound healing. Br J Dermatol. 2015;173:370–378.
[2] Chigurupati S, Mughal MR, Okun E, Das S, Kumar A, McCaffery M, Seal S, Mattson MP. Effects of cerium oxide nanoparticles on the growth of keratinocytes, fibroblasts and vascular endothelial cells in cutaneous wound healing. Biomaterials. 2013;34(9):2194–2201. doi:10.1016/j.biomaterials.2012.11.061.
[3] Tran NQ, Joung YK, Lih E, Park KD. In situ forming and rutin-releasing chitosan hydrogels as injectable dressings for dermal wound healing. Biomacromolecules. 2011;12:2872– 2880. doi:10.1021/bm200326g.
[4] Gopinath D, Ahmed MR, Gomathi K, Chitra K, Sehgal PK, Jayakumar R. Dermal wound healing processes with curcumin incorporated collagen films. Biomaterials. 2004;25:1911–1917. doi:10.1016/S0142-9612(03)00625-2.
[5] Finn G, Kirsner R, Meaume S, Munter C, Sibbald G. Clinical wound assessment a pocket guide, Coloplast 2006; p 6.
[6] Guo S, DiPietro L. Factors affecting wound healing. Journal of Dent Res 2010; 89: 219-29.
[7] Dabiri G and DiPersio M: Matrix metalloproteinases. In: Wound Healing, edited by Falabella A, and Kirsner R. Boca Raton, FL: Taylor and Francis, 2005, pp. 49–59.
[8] Robson MC, Krizek TJ, and Heggers JP: Biology of surgical infection. CurrProblSurg 1973; Mar: 1
[9] Forrest RD: Early history of wound treatment. J R Soc Med 1982; 75: 198.
[10] Okan D, Woo K, and Ayello EA: The role of moisture balance in wound healing. Adv Skin Wound Care 2007; 20: 39.
[11] Attinger CE, Janis JE, Steinberg J, Schwartz J, Al-Attar A, and Couch K: Clinical approach to wounds: debridement and wound bed preparation including the use of dressings and wound healing adjuvants. PlastReconstrSurg 2006; 117(7S): 72
[12] Broughton G, Janis J, and Attinger C: A brief history of wound care. PlastReconstrSurg 2006; 117(7S): 6.
[13] Ovington LG: Hanging wet to dry dressings out to dry. Home Healthc Nurse 2001; 19: 477.
[14] Dinner MI, Peters CR, and Sherer J: Use of semipermeable polyurethane membrane as a dressing for split-skin graft donor sites. PlastReconstrSurg 1979; 64: 112.
[15] Barnett A, Berkowitz RL, Mills R, and Vistnes LM: Scalp as a skin graft donor site: rapid reuse with synthetic adhesive moisture vapor permeable dressings. J Trauma 1983; 23: 148.
[16] Seaman S: Dressing selection in chronic wound management. J Am Podiatr Med Assoc 2002; 92: 24
[17] Choucair M and Phillips TJ: Wound dressings. In: Fitzpatrick's Dermatology in General Medicine, 5th edition, edited by Freedberg IM, Eisen AZ, Wolff K, Austen KF, Goldsmith LA, Katz SI, and Fitzpatrick TB. New York: McGraw-Hill Book Co., 2000, pp. 2954–2958.
[18] Ovington LG: The well-dressed wound: an overview of dressing types. Wounds 1998; 10: 1A.
[19] Varghese MC, Balin AK, Carter DM, and Caldwell D: Local environment of chronic wounds under synthetic dressings. Arch Dermatol 1986; 122: 52.
[20] Mulder G, Jones R, Cederholm-Williams S, Cherry G, and Ryan T: Fibrin cufflysis in chronic venous ulcers treated with a hydrocolloid dressing. Int J Dermatol 1993; 32: 304.
[21] Chvapil M, Holubec H, and Chvapil T: Inert wound dressings is not desirable. J Surg Res 1991; 51: 245.
[22] Barnea Y, Amir A, Leshem D, Zaretski A, Weiss J, Shafir R, Gur E: Clinical comparative study of aquacel and paraffin gauze dressing for split-skin donor site treatment. Ann PlastSurg 2004; 53
[23] Perkins K, Davey RB, and Wallis KA: Silicone gel: a new treatment for burn scars and contractures. Burns 1983; 9: 201. 528 SOOD ET AL.
[24] Li-Tasang CW, Lau JC, Choi J, Chan CC, and Jianan L: A prospective randomized clinical trial to investigate the effect of silicone gel sheeting (Cica-Care) on post-traumatic hypertrophic scar among the Chinese population. Burns 2006; 32: 678
[25] Warriner R and Burrell R: Infection and the chronic wound: a focus on silver. Adv Skin Wound Care 2005; 18: 2.
[26] Burrell BE: A scientific perspective on the use of topical silver preparations. Ostomy Wound Manage 2003; 49 (5A Suppl): 19
[27] Parry AD, Chadwick PR, Simon D, Oppenheim B, and McCollum CN: Leg ulcer odour detection identifies beta-haemolytic streptococcal infection. J Wound Care 1995; 4: 404
[28] Dhivya S, Padma VV and Santhinia E: Wound dressings a review, BioMedicine 2015; 5: 4. 24-28
[29] Sood A,Granick MS and TomaselliNL:Wound Dressings and Comparative Effectiveness Data, Advances In Wound Care, 2012; 3: 8